

Antarctic Astronauts

Antarctic researchers help JSC scientists learn about human isolation

By Eileen Hawley

The barren terrain of the Antarctic—bleak and harsh—looms for many miles in either direction as a group of explorers stands isolated against the stark whiteness.

They come to study the glaciers and the environment, spending up to one year in the isolated world of the Antarctic. Most recently, they also have been documenting their experiences and feelings to provide NASA with information on long-term existence in an extreme environment.

Researchers here at JSC, in partnership with the Australian Antarctic Division, are looking at long-term expeditions in Antarctica as an analog for future long-duration space flight. Using an innovative computer program to track the moods and responses of the expedition team members, JSC's Behavior and Performance Laboratory is gathering data that may help improve conditions for astronauts on future long-duration missions.

"The Antarctic environment offers many similarities to the space flight experience," said Deborah Harm, head of JSC's Neurosciences Laboratory. "Both require self-contained and self-supporting life support systems, and impose some level of isolation on the participants."

In 1988, a conference in California first looked at the Antarctic experience as a possible analog to space flight. In 1993, NASA and the Australian Government entered into a partnership to study the Australian expeditions to the Antarctic.

The Australian government has been sending expeditions to the Antarctic since 1947. Some groups winter over in the research settlement, while other smaller groups conduct tractor caravans during the summer to perform glaciological investigations. The JSC investigation currently is focusing on the interactions between members of two summer tractor traverse groups.

"The Antarctic hasn't changed since the days of Scott and his expeditions," said

Desmond Lugg, the head of Polar Medicine for the Australian Antarctic Division. "It's still dangerous and the climate is atrocious, much like you find in space."

A space-walking astronaut may experience temperature extremes ranging from minus 135 degrees Fahrenheit (minus 93 degrees Celsius) to plus 150 degrees Fahrenheit (plus 27 degrees Celsius) depending on whether they are exposed to sunlight or sheltered by the shuttle's payload bay or any other space structure, such as a satellite or the International Space Station.

By comparison, the Antarctic explorers live daily with temperatures of about minus 58 degrees Fahrenheit (minus 50 degrees Celsius) in the winter and 14 to minus 4 degrees Fahrenheit (minus 10 to minus 20 degrees Celsius) in the summer.

The caravans provide an excellent study group, with six participants spending up to 100 days traversing the Antarctic in tractors.

"They have routine chores to perform—keeping the tractors and life support systems going as

well as the glaciological investigations," Lugg said. "They venture outside the tractors, weather permitting, to dig pits to look at snow stratification and to put out weather stations. It's quite a strenuous program and on the first summer, they worked 14 days nonstop, so it probably is akin to astronauts in space maintaining themselves and performing experiments."

When weather doesn't permit outside activity, such as when a blizzard keeps the six men inside their vehicles for days on end, the isolation and inter-team relationships are put to the test. Once the blizzard abates and the expedition members venture outside, they are faced with the daunting task of digging the tractor out of the snowdrifts by hand.

"They are truly confined, and they drive very long hours," Lugg said. "They only move about five kilometers an hour and to cover 3,000 kilometers in 100 days—bearing in mind they can stop for hours on end

due to blizzards—they've got a very serious task."

Harm, in conjunction with Joanna Wood of the Behavior and Performance Lab, now has tracked two summer caravan groups and has 100 percent compliance from the participants.

"We looked at the various aspects of mood, group and individual performance, teamwork issues like cohesion, conflicts and conflict resolution," Wood said. "We are trying to get a good general sampling about how life is for the team members and how they respond to it."

The life has its dangerous and difficult moments. Much like astronauts on board a space shuttle or space station, the expedition members must share a limited space. While some astronauts venture out for space walks, so do expedition members venture out from the tractors to dig ice core samples.

"You can't travel any great distance away from the safety of the caravan," Lugg said. "The danger of stepping off into a crevasse is very real, and when you see some of the sizes of the crevasses, it's very dangerous. So, it's not the gravity effects or the vacuum of space, but you're still confined and isolated in an extremely unforgiving environment."

The customized software program developed by the Behavior and Performance Lab provides real-time readings on team members' responses to a variety of situations. The software is loaded on to a laptop computer that the caravan members take along with them. Twice a week, they respond to a questionnaire and the answers are stored on the computer for later analysis.

"The benefit is that you get the real story and not a sanitized version," Lugg said. "We have anecdotal evidence of conflicts between caravan members, but by the time they get back to Australia, the story is sanitized. This program is getting real time readings."

The questionnaire is designed to be easy to use. Some questions can be answered with a "yes" or "no," while others invite the respondent to write as much or as little as they please.

For completing the questionnaire, the respondent receives a "reward"—sometimes a digitized photo of home, the recorded voice of a family member, a short piece of film or a favorite piece of music.

The individual rewards were collected and placed on the computer by Wood and her colleagues.

"We asked them about things they were interested in," Wood said. "Cartoons or sounds. For instance, one person wanted to hear the sound of rain falling on the roof because there is no rain in Antarctica."

"The teams were very delighted with what they got," Lugg said. "It's these sorts of things that are important: color themes, private space, a favorite book. Even in their isolation, people like their little bit of privacy, yet they still want to see and experience the outside world."

Much like shuttle crews, the members of the expeditions represent specialists in a wide variety of disciplines working to support the overall mission. The groups that winter over in the Antarctic frequently find unique ways to keep themselves occupied. According to Lugg, they have occasionally formed a musical band, and often conduct lecture series.

"Everybody is a specialist in their own right," Lugg said. "Although they do have to share communal duties. Each person will take a turn and give their skills to the others. There's considerable intermixing of disciplines. Sometimes the chef will teach the others to bake bread and let them have a go at it."

There are a few unique positions in the expedition—a team leader, much like a mission commander; a chef and a medical doctor. The remaining team members, while specialists in their own field, perform much

as a mission specialist on board the shuttle working in a variety of disciplines.

Organizers of the Antarctic expeditions discovered it was more efficient to hire a chef for the winter groups for a number of reasons.

"It's more productive to have one person who is responsible for the cooking, when you consider that we're talking about three meals a day for 20 or more people in the winter groups," Lugg said.

According to Lugg, food is a very important consideration for extended, isolated stays.

On his first expedition to the Antarctic, Lugg ate pemmican—a jerkey-like dried meat—the staple of expeditions in the 1800s. The culture has changed and Lugg reports that expedition members now make full use of microwaves and improvements in food technology to eat traditional foods.

A medical doctor also is assigned to each team, although two other team members are trained in emergency care and all team members can perform basic first aid.

"On the shuttle in an emergency, you can get your people back very quickly," Lugg said. "With the winter groups, due to the extreme weather conditions, we're looking at nine months to return someone. The team is completely isolated and the aircraft is not capable of flying in to pick up an injured or ill team member."

The doctor must be able to deal with any emergency medical situation—from frostbite (a surprisingly rare occurrence considering the climate) to skull fractures—working with semi-trained assistants.

Another important factor in the mental well-being and morale of the team members, is color. In space, astronauts can enjoy spectacular views of the Earth and the skies, but in the Antarctic, the view is—in a word—white.

"When you join us, you get a red or yellow parka, blue socks, different colored jumpers," Lugg said. Everything is bright and that's important. Walls, floors, they all need to have some color to them."

Harm and Wood are just now looking at data gathered from the two summer tractor traverse groups and have partial data from a nine-month winter group.

"We have not yet identified any specific needs," Wood said.

According to Harm, the program looks not just at the group factors of leadership and team performance, but at the needs and desires of the individual team members as well.

"This is truly a unique opportunity, both for NASA and the Australian Antarctic program," Lugg said. "This is a true collaboration. There is no money exchanged between the two programs, it is a true collaborative effort and it's working exceedingly well." □



From Top to bottom, left to right: 1) Antarctic explorers travel in caravans spending up to 100 days traversing the cold glaciers during the summer to perform glaciological investigations. 2) Water chemical analysis helps scientists learn more about the Antarctic region. 3) Expedition members venture out from the tractor to dig ice core samples. 4) Large stations like the Mawson station near the expedition travel routes are desolate.

Photos courtesy of Australian Antarctic Division